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| DELPHI TECHNOLOGIES, INC. | | | PATEL, ISHWARBHAI B | |
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| TROY, MI 48007 | | | 2841 | |

DATE MAILED: 10/31/2005

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary

Application No.

10/709,209

Applicant(s)

SARMA ET AL.

Examiner

Ishwar (I. B.) Patel

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-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

- 1) ☒ Responsive to communication(s) filed on 21 April 2004.
- 2a) ☐ This action is **FINAL**. 2b) ☒ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

- 4) ☒ Claim(s) 1-20 is/are pending in the application.
- 4a) Of the above claim(s) 5 and 11-20 is/are withdrawn from consideration.
- 5) ☐ Claim(s) _____ is/are allowed.
- 6) ☒ Claim(s) 1-4 and 6-10 is/are rejected.
- 7) ☐ Claim(s) _____ is/are objected to.
- 8) ☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☒ The drawing(s) filed on 21 April 2004 is/are: a) ☒ accepted or b) ☐ objected to by the Examiner.
- Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
- Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

- 12) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☐ All b) ☐ Some * c) ☐ None of:
- ☐ Certified copies of the priority documents have been received.
 - ☐ Certified copies of the priority documents have been received in Application No. _____.
 - ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

- ☒ Notice of References Cited (PTO-892)
- ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
- ☒ Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08)
Paper No(s)/Mail Date 4/21/04, 7/11/05
- ☐ Interview Summary (PTO-413)
Paper No(s)/Mail Date. _____
- ☐ Notice of Informal Patent Application (PTO-152)
- ☐ Other: _____

DETAILED ACTION

Election/Restrictions

1. Restriction to one of the following inventions is required under 35 U.S.C. 121:
 - I. Claims 1-10, drawn to a circuit board assembly, classified in class 174, subclass 260.
 - II. Claims 11-20, drawn to a process of forming a circuit board assembly, classified in class 29, subclass 830+.

The inventions are distinct, each from the other because of the following reasons:

2. Inventions group II and I are related as process of making and product made.

The inventions are distinct if either or both of the following can be shown: (1) that the process as claimed can be used to make other and materially different product or (2) that the product as claimed can be made by another and materially different process (MPEP § 806.05(f)). In the instant case the product as claimed can be made by another and materially different process. The product can be made by using green tapes with preformed holes, instead of the steps of providing green tapes and then forming vias. Further, the product does not need to co-fire at a temperature of about 900° C. It can be co-fired at any other suitable temperature. Further, instead of depositing electrically conductive material in the via holes, metal stud can be inserted in the via holes.

3. Because these inventions are distinct for the reasons given above and have acquired a separate status in the art as shown by their different classification, and the search required for Group II is not required for Group I, restriction for examination purposes as indicated is proper.

4. If group I is elected, claims 1-10 are further subject to an election of species, for being drawn to more than a single species, defined below.

Specie I Figure 2.

Specie II Figure 3

Applicant is required under 35 U.S.C. 121 to elect a single disclosed species for prosecution on the merits to which the claims shall be restricted if no generic claim is finally held to be allowable. Currently, claims 1 and 10 are generic.

Applicant is advised that a reply to this requirement must include an identification of the species that is elected consonant with this requirement, and a listing of all claims readable thereon, including any claims subsequently added. An argument that a claim is allowable or that all claims are generic is considered nonresponsive unless accompanied by an election.

Upon the allowance of a generic claim, applicant will be entitled to consideration of claims to additional species which are written in dependent form or otherwise include all the limitations of an allowed generic claim as provided by 37 CFR 1.141. If claims

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are added after the election, applicant must indicate which are readable upon the elected species. MPEP § 809.02(a).

Should applicant traverse on the ground that the species are not patentably distinct, applicant should submit evidence or identify such evidence now of record showing the species to be obvious variants or clearly admit on the record that this is the case. In either instance, if the examiner finds one of the inventions unpatentable over the prior art, the evidence or admission may be used in a rejection under 35 U.S.C. 103(a) of the other invention.

5. During a telephone conversation with Gary Hartman (Reg. 33,898) on July 18, 2005 a provisional election was made with traverse to prosecute the invention of group I, specie I, claims 1-4 and 6-10. Affirmation of this election must be made by applicant in replying to this Office action. Claims 5 and 11-20 are withdrawn from further consideration by the examiner, 37 CFR 1.142(b), as being drawn to a non-elected invention.

6. Applicant is reminded that upon the cancellation of claims to a non-elected invention, the inventorship must be amended in compliance with 37 CFR 1.48(b) if one or more of the currently named inventors is no longer an inventor of at least one claim remaining in the application. Any amendment of inventorship must be accompanied by a request under 37 CFR 1.48(b) and by the fee required under 37 CFR 1.17(i).

Claim Objections

7. Claims 1-10 are objected to because of the following informalities:

Regarding claim 1, the phrase "consist essentially of electrically nonconductive material", line 5-6, is misleading. As there are conductive vias and conductor lines claimed in/on the first layer, **the first region** does consist electrically conductive material. It may be changed to "the layers consist essentially of electrically nonconductive material".

Claims 2-9 depend upon claim 1 and inherit same deficiency.

Similarly regarding claim 10, the phrase "consist essentially of electrically nonconductive glass and ceramic material", line 5-7, is misleading. As there are conductive vias and conductor lines claimed in/on the first layer, **the first region** does consist electrically conductive material. It may be changed to "the layers consist essentially of electrically nonconductive material".

Appropriate correction is required.

Claim Rejections - 35 USC § 103

8. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

9. Claims 1-4 and 6-10 are rejected under 35 U.S.C. 103(a) as being unpatentable over Polinski, Sr., US Patent No. 5,386,339 (Polinski).

Regarding claim 1, Polinski, in an embodiment of figure 5, discloses a circuit board assembly comprising: a co-fired substrate comprising at least first (made up of sheet 122) and second (made up of 148) regions superimposed and bonded to each other, the first region being formed of first ceramic layers (LTCC sheet 122) that are superimposed and consist essentially of electrically-nonconductive materials (dielectric structure 124, column 6, line 1,2), at least some of the first ceramic layers being bonded to each other (see figure), the second region being formed of at least one second ceramic layer (148), conductor lines on at least some of the first ceramic layers so as to be between adjacent pairs of the first ceramic layers; electrically-conductive vias that extend through at least some of the first ceramic layers and electrically interconnect the conductor lines on the first ceramic layers (explained in the first embodiment, column 3, line 59-64); and a surface-mount IC device (130) mounted to a first surface of the substrate defined by one of the first ceramic layers. Polinski, though discloses the second region (148) with higher thermally conductivity (column 5, line 58-59), does not explicitly disclose thermally-conductive particles dispersed in a matrix comprising electrically-nonconductive materials, the thermally-conductive particles having a higher coefficient of thermal conductivity than the electrically-nonconductive materials of the first and second ceramic layers. However, Polinski further recites that additives can be added to improve the thermal conductivity (column 4, line 36-44).

Therefore, it would have been obvious to a person of ordinary skill in the art at the time of applicant's invention to provide the second region (148) be formed with

thermally-conductive particles dispersed in a matrix comprising electrically-nonconductive materials, the thermally-conductive particles having a higher coefficient of thermal conductivity than the electrically-nonconductive materials of the first and second ceramic layers, in order to have higher thermal conductivity of the second region for fast dissipation of heat from the system.

Regarding claim 2, Polinski further discloses the substrate is a low-temperature co-fired ceramic substrate (sheets 122 and 148 made of low-temperature co-fired ceramic material, column 6, line 1,2 and column 5, line 45).

Regarding claim 3, Polinski further discloses the thermally conductive particles are metal and/or ceramic particles (column 4, line 37-52).

Regarding claim 4, the substrate of Polinski does not have thermal via extending through the substrate from the surface mount device on the first surface to an oppositely disposed second surface of the substrate (no via in the second region 148, see figure).

Regarding claim 6, Polinski discloses all the features of the claimed invention but does not disclose the second ceramic layers have a coefficient of thermal expansion of within about 4 ppm/°C of first ceramic layers. However, it is advisable to control the coefficient of thermal expansion of both layers of first and second region to avoid

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developing cracks at the bonding junction due the uneven expansion. Further the coefficient of thermal expansion will depend upon the additive used in the layers and can be controlled by changing the proportion and type of additives. Furthermore, it has been held that discovering an optimum value of a result effective variable involves only routine skill in the art. *In re Boesch*, 617 F.2d 272, 205 USPQ 215 (CCPA 1980).

Therefore, it would have been obvious to a person of ordinary skill in the art at the time of applicant's invention to keep the coefficient of thermal expansion as close as possible to that of the first ceramic layers, and for that matter within about 4 ppm/°C of first ceramic layers, in order to avoid crack development at the bonding junction.

Regarding claim 7, Polinski discloses all the features of the claimed invention including the second ceramic layers but does not disclose the second ceramic layers have a thermal conductivity of at least 10 W/mK. However, as applied to claim 1 above, additives are added to improve the thermal conductivity to the desired value to facilitate faster heat removal to protect the device from the damage. Further, it has been held that discovering an optimum value of a result effective variable involves only routine skill in the art. *In re Boesch*, 617 F.2d 272, 205 USPQ 215 (CCPA 1980).

Therefore, it would have been obvious to a person of ordinary skill in the art at the time of applicant's invention to provide structure of Polinski with the second ceramic layers have a thermal conductivity of at least 10 W/mK, in order to have desired thermal conductivity to avoid damage to the system due to higher temperature.

Regarding claim 8, Polinski discloses all the features of the claimed invention including the second region free of the first ceramic layers, the first ceramic layers are bonded surface-to-surface to form the first region of the substrate, and the first region is free of the second ceramic layers and is bonded to the second region of the substrate (see figure), but does not disclose the second ceramic layer is one of a plurality of second ceramic layers bonded surface-to-surface to form the second region of the substrate. However, the second region of Polinski is made of higher thermal conductivity to facilitate faster heat removal. Adding more layer will help in enhancing heat removal. Therefore, it would have been obvious to a person of ordinary skill in the art to modify the structure of Polinski having the second ceramic layer is one of a plurality of second ceramic layers bonded surface-to-surface to form the second region of the substrate, in order to enhance heat removal rate to avoid damage to the system.

Regarding claim 9, Polinski further discloses a heat sink (24) bonded to the substrate, the second region of the substrate being between the heat sink and the first region of the substrate (see figure).

Regarding claim 10, Polinski discloses all the features of the claimed invention including the first region and the second region and an a surface mount IC device mounted to a first surface of the substrate, as applied to claims 1, 4, 6, 7 and 8.

Conclusion

10. The prior art made of record and not relied upon is considered pertinent to applicant's disclosure.

Takehara et al. US Patent No. 6,794,747, in figure 1A, discloses a device comprising a high thermo conductive core ceramic substrate with (low temperature co-fired ceramic) LTCC substrates.

Schroeder, US Patent No. 5,347,091 disclose a multilayer board with LTCC substrate 5 and 6 around aluminum nitride core 4.

Takehara et al., US Patent No. 6,818,979, in figure 1, discloses a device with a substrate (2) made of LTCC ceramic layers.

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Ishwar (I. B.) Patel whose telephone number is (571) 272 1933. The examiner can normally be reached on M-F (8:30 - 5:00).

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Kamand Cuneo can be reached on (571) 272 1957. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

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Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).



Ishwar (I. B.) Patel
Examiner
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October 27, 2005